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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 14 April 2003 with an application for Letters Patent number 525308 made by DAVID ARTHUR LEE.

Dated 25 November 2003.

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NEW ZEALAND

PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

METHOD AND APPARATUS FOR PRODUCING A REINFORCED YARN

I, **DAVID ARTHUR LEE**, a New Zealand citizen, of 177 Maces Road, Christchurch, New Zealand, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement.

FIELD

The invention comprises a method and apparatus for producing a yarn.

BACKGROUND

In producing a yarn a number of slivers may, typically after drafting, be passed through a twisting stage which comprises reciprocating rotating rollers which move from side to side as the wool slivers pass between the rollers, thereby imparting a twist to the strands. After exiting the twist rollers, the strands are brought together to twist naturally with each other to form a multi-ply yarn.

SUMMARY OF INVENTION

The present invention provides an improved or at least alternative method and apparatus for producing a yarn comprising a plurality of twisted strands made up of staple fibres and including a core.

In one aspect the invention broadly comprises a method for producing a yarn including passing one or more slivers made up of staple fibres through a reciprocating twisting stage adapted to simultaneously twist the slivers to produce one or more twisted strands, including passing the sliver(s) beneath a roller and introducing a core filament or filaments to the sliver(s) or at least one sliver so that the continuous filament(s) pass(es) beneath the roller with the sliver(s) and is pressed into the sliver(s) before the sliver(s) pass through the reciprocating twisting stage.

In another aspect the invention broadly comprises apparatus for producing a yarn including a reciprocating twisting stage adapted to simultaneously twist one more slivers made up of staple fibres to produce one or more twisted strands, at least one roller before the reciprocating twisting stage, and at least one guide arranged to introduce a core filament so that the filament or filaments pass beneath the roller with the sliver(s) and is/are pressed into the sliver(s) by the roller before the sliver(s) pass through the reciprocating stage.

Preferably the core filament is a continuous synthetic filament or filaments. Alternatively however the core filament may be spun from non-synthetic and/or staple fibres such as non-continuous synthetic filaments spun together, or natural fibres such as spun silk or cotton for example.

Preferably the reciprocating twisting stage comprises one or more rollers arranged to move reciprocally along the axis of rotation of the roller(s) to impart twist to the sliver(s). Preferably any one or more of the transverse speed, the extent of the transverse movement or throw, and the rotational speed of the one or more rollers of the reciprocating twisting stage can be varied to achieve the desired degree of twist or twist profile in the strands of the yarn. The apparatus may include an associated control system including a microprocessor, PLC, or similar which controls the transverse movement or throw, and/or the speed of transverse movement, and/or the rotational speed of the one or more rollers and/or which enables a user to programme the degree of twist or twist profile to be imparted to a production run, series of production runs, or part run.

BRIEF DESCRIPTION OF THE DRAWINGS

The method and preferred forms of apparatus of the invention are described with reference to the accompanying drawings by way of example and without intending to be limiting, wherein:

Figure 1 schematically shows one form of apparatus of the invention from above,

Figure 2 shows the apparatus from one side, showing the drafting unit and twisting rollers thereof,

Figure 3 shows the strands exiting the twisting rollers of the apparatus of Figures 1 and 2 being brought together by guides,

Figure 4 is a close up view from below showing introduction of one continuous filament through a guide in another form of apparatus of the invention, and

Figures 5A is a view of a length of one example of yarn which may produced by the apparatus of the invention, and Figure 5B schematically shows one option for the relative positions of the twisted areas in each strand made up of staple fibres making up this yarn.

DETAILED DESCRIPTION OF PREFERRED FORM

Referring to Figures 1 and 2 a preferred form apparatus comprises a drafting unit 5 comprising opposed moving preferably rubber coated rollers or belts, between which the fibres pass (as slivers). In the example shown, three slivers (unspun) of for example wool drawn from drums or other bulk supply (not shown), are fed between rollers 4 and through the drafting unit 5 and are drawn out - typically the thickness of the wool fibre assembly is reduced to between one half to one twenty-fifth of the initial thickness. The amount of thickness reduction may be adjusted by altering the rotational speed of the drafting unit.

A reciprocating twisting stage 6 comprises a pair of rollers 6a and 6b, one or both of which rotate as well as reciprocate back and forth across the direction of movement of the strands as the apparatus operates. The twist rollers 6 impart twist in one direction as the roller(s) move(s) one way followed by twist in another direction as the roller(s) move(s) the other way in operation. In addition, areas of non-twist may be formed in the strands at the point at which the roller(s) change(s) direction. Alternatively a single reciprocating roller may move relative to a flat surface over which the strands pass, to twist the strands between the roller and surface.

The extent of the transverse reciprocating movement or throw of the roller 6a and 6b may be varied to achieve the desired degree of twist in the strands or twist profile of the yarn. Additionally or alternatively the desired degree of twist may be obtained by varying the rotational speed of the twist rollers 6a and 6b. Additionally or alternatively again the degree of twist or twist profile may be varied by adjusting the speed of reciprocating the transverse movement of the twist roller(s) (relative to their rotational speed). The variation in the speed

of transverse movement and/or throw and/or rotational speed of the twist roller(s) may be controlled by a microprocessor-based control system. Variation in the throw and/or rotational speed of the twist rollers may be achieved by servomotors or other suitable equivalent mechanical or electro-mechanical means.

A user may programme roller speed, the extent of roller transverse movement, and the rate of roller transverse movement, for any production run to achieve a desired twist profile in the strands or resulting multi-ply yarns.

Prior to the reciprocating twist rollers 6a and 6b rollers 7 are provided, with associated ring guides 8a-c. Each strand or sliver passes through one of the guides and between (non-reciprocating) rollers 7. Continuous filaments 12 are introduced at and pass through the guides with the strands also, and between the rollers 7. Preferably the continuous filaments are a synthetic monofilament such as a nylon mono filament, but each might alternatively be a synthetic multifilament or a non-synthetic spun filament for example. As each strand of wool for example and filament pass through a guide and between rollers 7, the continuous filament is pressed into the strand or sliver between the rollers 7, before the strand and filament pass through and are twisted by the reciprocating twist roller 6. Alternative to providing two rollers 7 for this purpose, the strands and filaments may pass between a single roller acting against a flat surface over which the strands pass, to press the filaments into the strands between the roller and surface. The filaments are pressed into the middle of the filaments composed at least predominantly of staple fibres, so that the synthetic filament becomes surrounded by the fibres of the strand. The continuous synthetic filament adds strength to the strand which as a result can be twisted less to achieve higher bulk, thus providing a yarn with greater bulk for a given weight of wool, without loss of tensile strength.

Figure 4 is a close up view from below of another form of apparatus of the invention slightly different to that of Figures 1 and 2 but in which continuous filaments are introduced to the strands of staple fibres between rollers, in close up view from below. Reference numeral 7 in Figure 4 indicates rollers which perform the same purpose as rollers 7 in Figures 2 and 3 as referred to previously. A strand of wool or similar is indicated schematically at 11. A

synthetic filament 12 passes through tubular guide 13 and between the roller 7 where it is pressed into the fibres of the strand or sliver 11 as before. The strand incorporating the continuous synthetic filament embedded therein is indicated at 14 exiting the rollers 7 on the other side.

Referring to Figure 3, in the machine of Figures 1 and 2 following the reciprocating twisting stage, to produce one form of yarn one or more of the strands is led directly through primary guide or eyelet 1b, while the other strands are led through secondary guides or eyelets before also passing through primary guide 1b, so that some strands have a different path length before entering primary guide 1b. Strand 2 passes through guide 2b whilst strand 3 passes through guide 3b before both passing through primary guide 1b. As the strands exit the eyelet 1b they tend to self-twist together, or alternatively, a further twisting mechanism may optionally be provided to assist in twisting the three (or more) strands together to form the finished yarn. Such a further twisting mechanism may be controlled to enable the extent to which the individual strands are twisted together to be varied ie to enable control of the "twist within the twist" of the yarn. Each of the strands passes over a path of different length relative to the other strands, so that the areas of twist in each of the strands are staggered, or out of phase, relative to one another. In this form of yarn the different path lengths are such that the areas of non-twist in each strand are overlaid with areas of twist in other strands in the finished yarn. The resulting yarn is schematically shown in Figures 5A and B. Referring to Figures 5A and 5B, the yarn example illustrated comprises three twisted strands which are loosely twisted together to form the finished yarn. Each of the strands 1, 2, and 3 are "staggered", or out of phase, relative to each other, so that areas of non-twist 1a, 2a, and 3a in each of the strands of the yarn are overlaid by areas of twist in the other strands, as shown. Figure 5A exaggerates this for clarity. In the finished yarn, the areas of non-twist in one strand are overlaid by areas of twist in the other strands. Figure 5B seeks to schematically illustrate this – in Figure 5B the three strands are shown parallel (before any twisting together) and in each strand the areas of twist (in alternate directions) formed by the twist roller(s) 6 are indicated in hard outline while the areas of non-twist between the areas of twist are indicated in broken outline, as indicated at 1a, 2a, and 3a, for example. Any area of non-twist in any strand, such as non-twist area 1a, is overlayed for at least part of its length

by areas of twist in the other strands as shown. Figure 5A also shows continuous filament 12 embedded within the strands (but not shown in Figure 5B).

The foregoing describes the invention including a preferred form thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

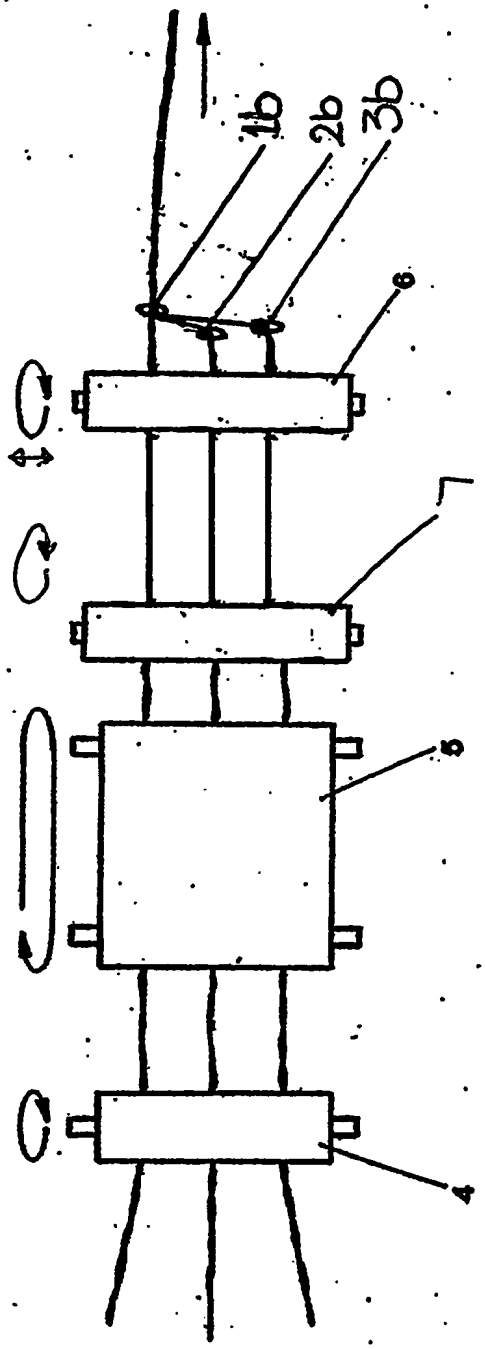

FIGURE 1

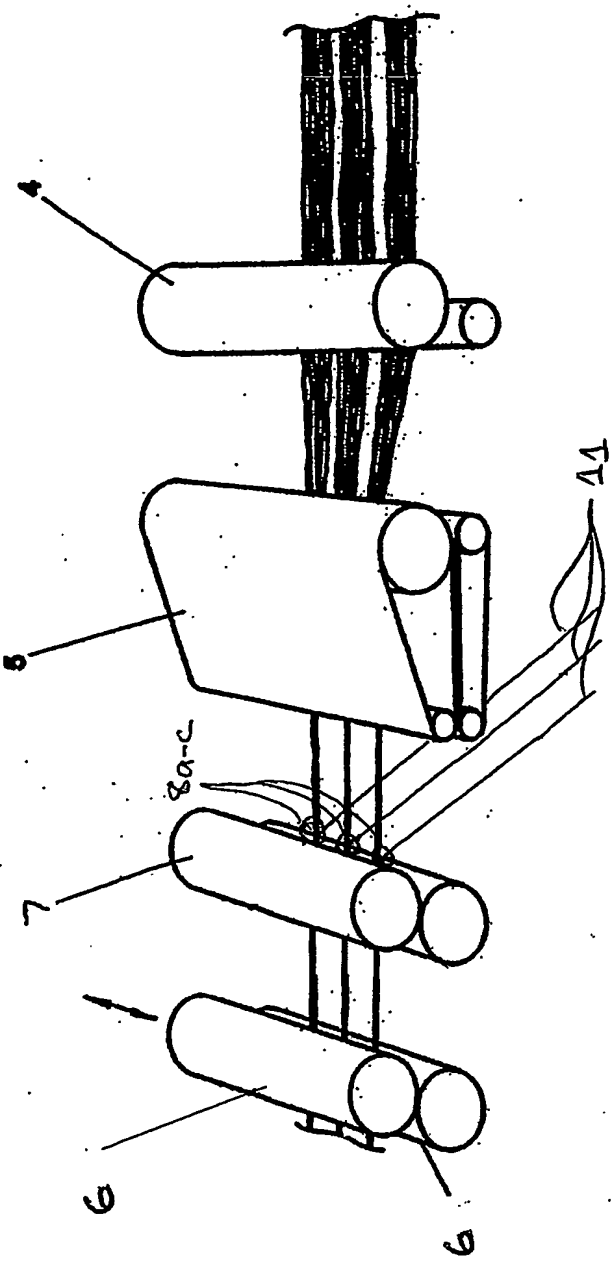

FIGURE 2

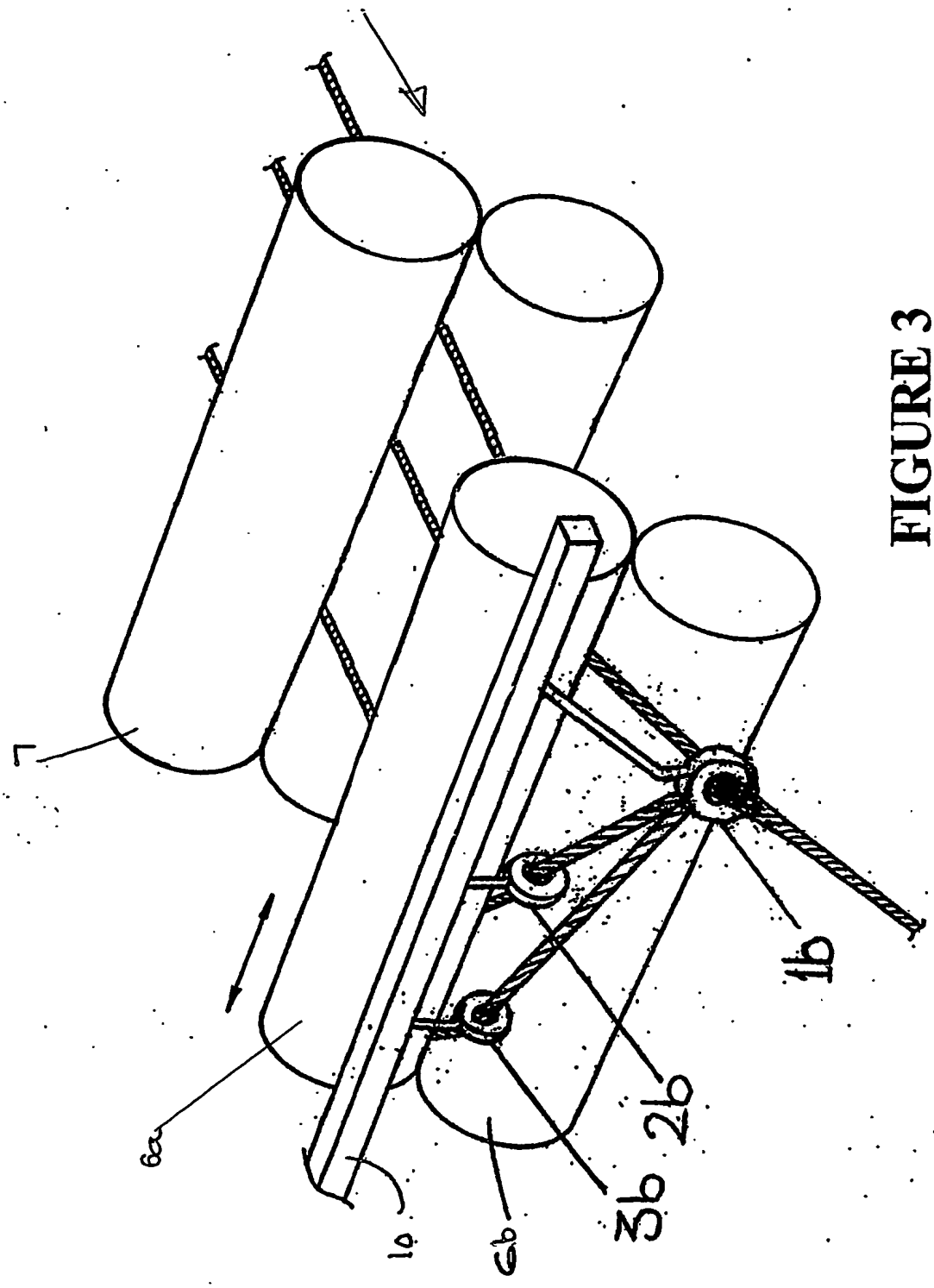

FIGURE 3

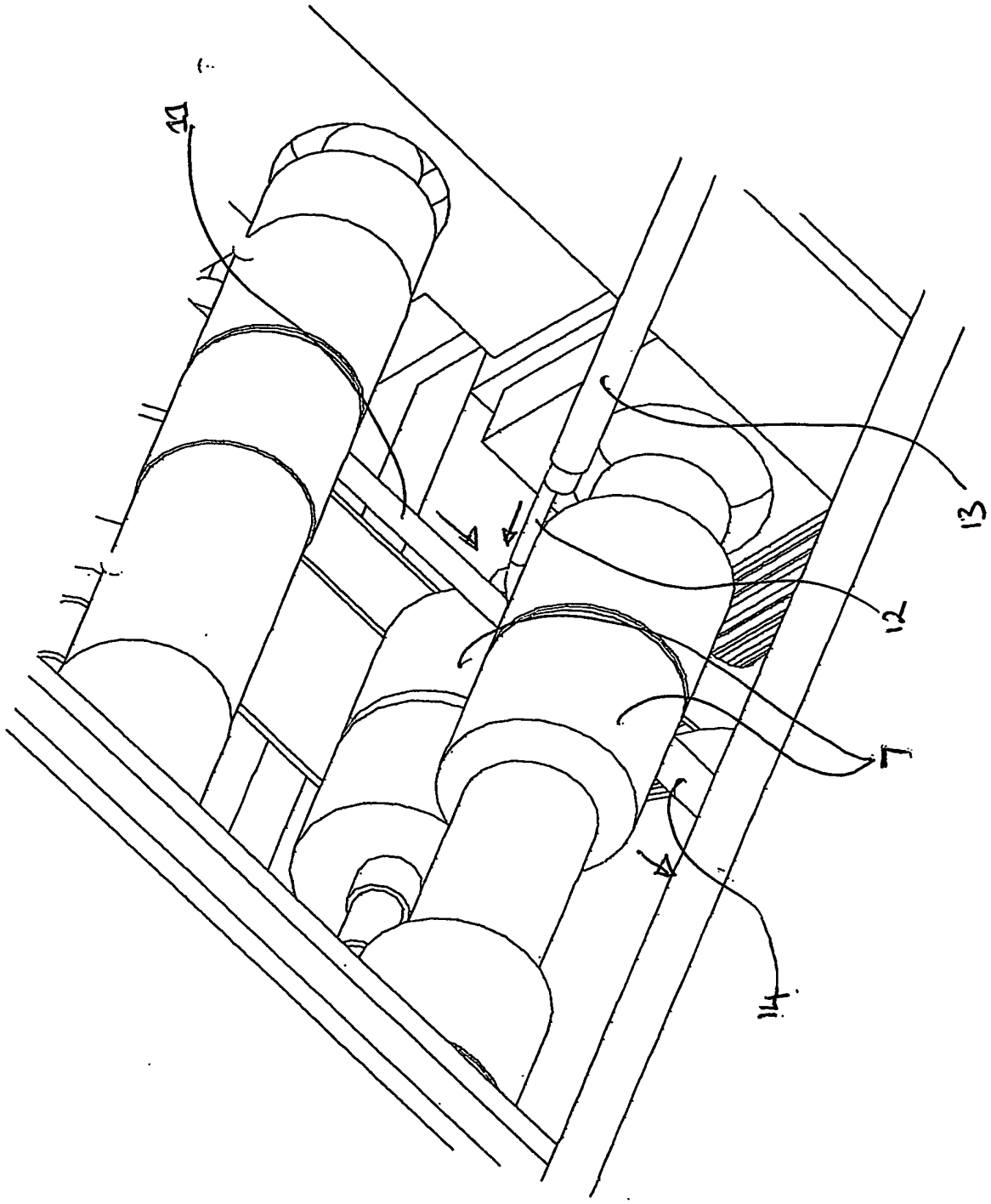

FIGURE 4

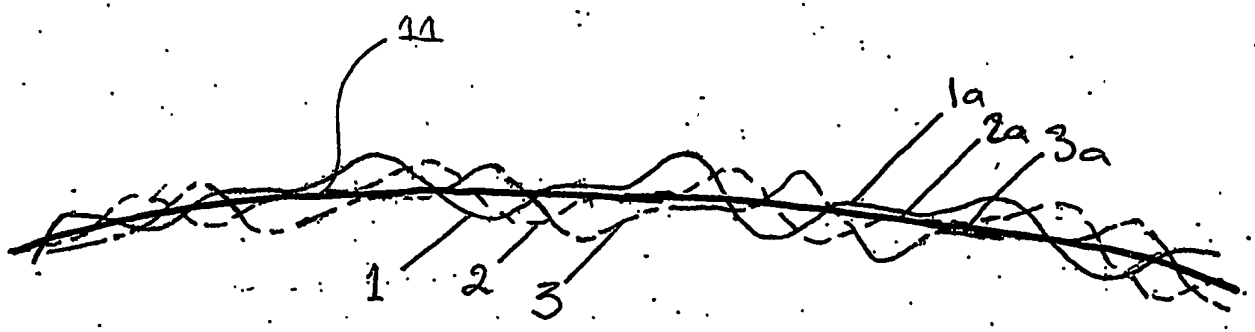

FIGURE 5A

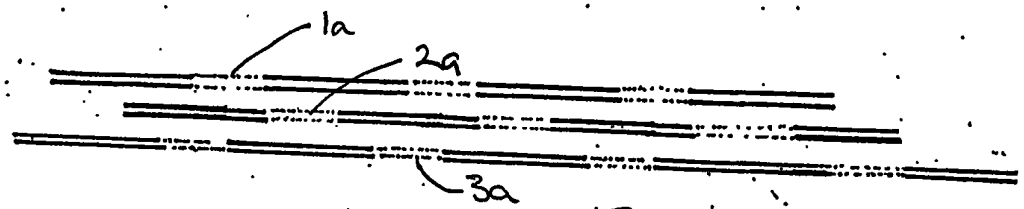

FIGURE 5B